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UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

ANNUAL INVESTIGATIVE REPORT FOR 1929

and

PROGRAM FOR 1930

NORTHERN REGION
and
NORTHERN ROCKY MOUNTAIN FOREST EXPERIMENT STATION
MISSOULA, MONTANA

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ANNUAL REPORT FOR 1929

and

PROGRAM FOR 1930

of the

DISTRICT I INVESTIGATIVE COUNCIL

For the Investigative Council

EVAN W. KELLEY
Chairman.

Approved May 10, 1930.

R. H. WEIDMAN
Secretary.

EVAN W. KELLEY
District Forester.

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ANNUAL REPORT OF THE DISTRICT I INVESTIGATIVE COUNCIL FOR 1929

AND PROGRAM FOR 1930

The annual meeting of representatives of all agencies engaged in forest research in the northern Rocky Mountain region was held this year in Spokane, January 13, 14 and 15, 1930. It was the first time that this meeting has been held outside of Missoula, and the selection of Spokane was found to be very advantageous in general convenience, and in obtaining a much more representative attendance from users, as well as producers of research results. Although the present report is intended primarily to cover the work of the Experiment Station and other Forest Service offices in the region, it includes also condensed statements of the excellent research conducted by the other agencies.

PERSONNEL OF THE COUNCIL

Eleven classes of forest agencies were represented at this council meeting, as follows:

U. S. Forest Service: E. W. Kelley, chairman of the meeting; R. H. Weidman, secretary; Elers Koch, W. W. White, M. I. Bradner, H. R. Flint, T. Lommasson, D. S. Olson, I. T. Haig, H. T. Gisborne, all from the District Office or the Experiment Station, and Supervisor J. E. Ryan of the Kaniksu Forest.

Forest Schools: Dean T. C. Spaulding and Professor J. H. Ramskill of the University of Montana; and Dean F. G. Miller and Professor E. E. Hubert of the University of Idaho.

Blister Rust Control: S. N. Wyckoff, in charge of the Spokane Office, and H. N. Putnam and C. C. Strong, assistants.

Consulting Foresters: Carl M. Stevens and Donald Bruce of the firm of Mason & Stevens; and Norman G. Jacobson, representing the Western Forestry and Conservation Association.

Private Timber Operators: C. L. Billings, Assistant General Manager of the Clearwater Timber Company.

Weather Bureau: E. M. Keyser, in charge of the Spokane office and F. C. Crombie, assigned to fire weather work in this region.

Entomology: J. C. Evenden, in charge of the work of the Bureau of Entomology in this district.

Forest Research in British Columbia: Dr. P. M. Barr, Director of Research.

State Foresters' Offices: A. J. Perry, Deputy State Forester of Idaho.

Timber Protective Associations: R. L. Woesner, of the Potlatch Association, as well as Dean Spaulding, for the western Montana Associations.

Indian Service: Lee Muck, of the Spokane office.

The value of this enlarged meeting and the degree of interest shown were clearly revealed when the question was raised whether or not a similar meeting would be desirable in 1931. The vote in favor of such a meeting was practically unanimous. The selection of the location for the next meeting was left to the chairman, after numerous statements of approval of Spokane as a desirable center.

MATTERS OF GENERAL INVESTIGATIVE POLICY

In his opening remarks as chairman, District Forester Kelley referred to the reasons for meeting at Spokane, emphasizing the complexity of forest factors and problems of the western white pine timber type, which has its outlet at this point. He mentioned the urgent need of research for the above reasons and because of the value of the timber and the active logging and lumber manufacturing of the locality. He stressed the need of more adequate funds for forest research there and for commencing work in parts of Montana. He pointed out the need of bringing both the forest problems and the results of research to the attention of the public in general, and the desirability of providing those most interested in forest lands with a more intimate knowledge of research plans and results.

Getting Out Results

Throughout the entire meeting there was repeated emphasis on the need of current information covering research results. In this connection Mr. Stevens pointed out the fact that many private operators are pressed by lack of knowledge into certain investigations, some of which may be under way or even completed by the Forest Service and other agencies without coming to the attention of the operator in question. Speeding up of publication of results or distribution of preliminary reports were advocated.

The manner of presenting projects to the council meeting came up for discussion, as it does perennially. The method employed this year was by status sheets which purposely kept to a minimum the details of results. Most of the men at the meeting, however, seemed to feel the lack of this abbreviated form of presentation and continually asked for concrete facts. It was agreed that at the next meeting each agency should submit a statement of its results and plans in the form of a memorandum, somewhat as was done in former years. The status sheets are essential, however, as a background which should be acquired by the delegates before entering the meeting.

Number of Research Projects and Expenditures by Different Agencies

A correlation of statements called for previous to the meeting

TABLE I

Expenditures by Lines of Research Work
Northern Rocky Mountain Region
For the Calendar Year 1929

Line of Work	Agency						Total	Per cent
	Blister Rust Control	Forest Service	Univ. of Idaho	Bureau of Entomology	Weather Bureau	Univ. of Montana		
Art. Reforestation		$600	$700			$200	$1,500	1.1
Management		8,817	2,750			550	12,117	8.9
Mensuration		811	1,450			25	2,286	1.7
Protection	$54,000	11,771	2,530	$14,000	$3,610		85,911	63.1
Products		11,480°	6,916			1,350	19,746	14.5
Grazing		750°				300	1,050	0.8
Ecology		229					229	0.2
Economics		4,835°	1,560			225	6,620	4.9
General and Miscellaneous		5,813	750				6,563	4.8
Total	$54,000	$45,106	$16,656	$14,000	$3,610	$2,650	$136,022	100.00

° Includes contributed time by Forest officers.

shows that 106 distinct projects are being carried by six agencies, as follows: Forest Service, 49; University of Idaho, 19; University of Montana, 18; Bureau of Entomology, 13; Office of Blister Rust Control, 6; and Weather Bureau, 2. The expenditures for the calendar year 1929 were reported by agencies as shown in Table 1.

This total expenditure of $136,000 is a marked increase compared to the total of $88,000 reported for the year 1927, the first time such a compilation was made for this region. This increase, however, is probably not due entirely to new funds made available for research work, but is partly due to the more accurate compilation by all agencies this year. Whereas the first attempt to summarize expenditures was largely a matter of estimate by each agency, the present tabulation was anticipated more thoroughly and the data are undoubtedly more complete and dependable.

The expenditures by the Forest Service, shown in Table No. 1, were made by five offices, as follows: Experiment Station $20,691, Office of Forest Products $16,315, Operation $6,350, Management, including Planting, $1,000, and Grazing $750. The Experiment Station budget was subdivided into the following classes: Three fire research projects, $5,421 or 26%; maintenance, improvements and supervision of the Priest River Experimental Forest, $4,894 or 24%; methods of cutting study, $4,433 or 21%; study of timber growing and logging practice in western yellow pine, $2,082 or 10%; reproduction study, $1,902 or 9%; volume, growth and yield studies, $811 or 4%; phenological investigations, $229 or 1%; and other miscellaneous studies, $919 or 5%. About 90% of the Experiment Station funds is devoted to studies in the white pine type.

The work by the Office of Forest Products was divided between products research which took $11,480 or 70% of that office total, and economic and statistical studies which utilized $4,835 or 30%. These amounts include the contributed time, in salary and expenses, of Forest officers, not members of the Products office who were detailed on active projects. The Office of Management used $600 on artificial reforestation, and $400 on studies of silvicultural practices. The entire expense of the Office of Operation was devoted to five projects in protection. The $750 reported by the Office of Grazing consisted entirely of contributed time.

From this review of the general distribution of forest research work in this region it appears that two-thirds of the effort is being devoted to the several phases of forest protection. It is also worth noting that in the expenditure of approximately $86,000 on studies of forest protection, the Forest Service contributed less than 14%, while the Bureaus of Entomology and Plant Industry combined contributed 79%. Only 4% of the total was available for both research and routine work in weather forecasting which is conceded as fundamentally important to most successful fire control. As will be shown later in this report, all of the present research in protection is deemed to be vitally important, but it was the consensus of opinion at the Spokane meeting that the importance of fire weather research and the volume of data available for such studies deserve early and large increases in funds.

Forest Research Needs Demanding Expanded Program

It was again recognized by the Council this year that the regional research needs are far from being adequately met and that there should be early increase of funds to make at least a start in that direction. Without attempting to indicate the order of priority, the lines of research work which have been generally recognized as needing first attention when increased funds become available are the following: Fire control, forest management, grazing, products, forest resource survey, and fire weather investigations by the Weather Bureau. There are other needs involving chiefly protection against insects and other enemies of the forest, not the least of which is the need for a pathologist on tree diseases, wood decay and slash deterioration problems, but it is felt that these matters must await later increases and should not be taken up at this time.

The present Experiment Station funds provide for a staff of only four men, of which one is a Station ranger. Thus only one man is available for fire control studies, one for forest management studies, and one for supervision and participation in all lines of work and for handling special projects.

Everyone concedes the vital importance of fire control in the northern Rocky Mountain region and recognizes the need of adequate research to help improve the situation. The present studies of lightning behavior in starting fires, fuel inflammability and weather relationships, and fire weather reporting and forecasting (in co-operation with the Weather Bureau) should be continued. These projects, particularly the first two, should not be intensified at this time, however, for the reason that protection practice is not prepared to use more refined knowledge of weather and inflammability until there is much greater improvement in the physical and human features of actually discovering fires more quickly and getting men much more rapidly to them than is now done. The outstanding fact in reviewing the experience of 1926 and 1929 is that protection organizations are still unable during such bad seasons to get fires while they are small. The urgent problem, therefore, to which increased research funds should be devoted at the start is to ascertain the facts that will help protection agencies get on top of the very practical problem of detecting and getting men to fires more quickly. Summed up, this means reducing hour control to the shortest time possible. The project will involve all aspects of elapsed time including the determination of relatively safe hour control for the different forest or inflammability types. Following that the human failures involved in suppression will call for research help. The details concerned in these matters will be made the subject of a separate communication to the Branch of Research. It is recommended that $15,000 be provided for expanded fire studies of this sort.

The inadequacy of forest management studies has repeatedly been emphasized at the annual investigative meetings. The system of permanent sample plots built up by the Experiment Station is just beginning to meet the needs for basic study of methods of cutting, thinning and regenerating forest crops in the northern portion of the Idaho white

pint type. This system of plots should at an early date be extended to representative experimental centers in the central and southern portions of this forest type--sections which differ from each other in their essential forest conditions. A comprehensive set of normal yield tables, as well as second growth volume tables, for the rather complex white pine type has been completed as the result of several years' work. This major yield project, however, will not be complete until the needed yield application study can be made. The larch-fir forest comprises perhaps the largest type in the region and furnishes the greatest part of the lumber cut of Montana. There is need for early extension of at least preliminary research to this timber type. These studies of cutting and regeneration, and of volume, growth and yield, in the different types, are basic to the evolution of correct practice in both National Forest management and private timber growing. Moreover, they furnish the information necessary for carrying out certain phases of the forest survey.

In the case of timber growing, research must do more than it has in this region if there is to be any progress in the most important forestry problem that confronts the Nation, viz., the leaving and maintaining of cut-over land in a productive condition. Much of the private timber land at lower elevations in the white and yellow pine types has a relatively good timber producing capacity, which it is believed holds possibilities of profitable investment of capital in timber growing and logging as a permanent business. Some Forest Service research together with the activity of other agencies is needed to investigate the possibilities and help point the way to their realization.

At present only one member of the Experiment Station staff can give full time to management studies and all of his effort is required solely to make annual and periodic measurements necessary to keep the existing permanent sample plots going. To undertake the yield application and other mensuration studies, to start preliminary studies in the larch-fir type, and to give some concrete help to private timber land owners in the white pine type will require at least $15,000. It is understood that possibly only $10,000 can be included in the appropriation estimates for such work. If only this amount is received the work should be confined to the Idaho white pine region. It is hoped the additional amount requested can be obtained in order to start work in Montana.

The grazing of live stock is next to timber production the next important use of forest land in the northern Rocky Mountain region. The live stock industry, in fact, is absolutely dependent on National Forest and private timberland for its summer range. On the other hand, grazing rental furnishes an annual return per acre in both virgin and cut-over timber that helps defray annual holding costs of land. Grazing research is needed to furnish the basis for intelligent management of these important and destructible range resources of the region. The nature of the studies needed is indicated in another section of this report. There are no research funds at all available for the purpose now. To start this grazing research, not only in the vast plains and open timber ranges of eastern Montana, but also in the denser forest conditions and the cut-over and burned-over lands of northern Idaho and western Montana, an allotment of $25,000 is required to handle the work on a proper scale. It is proposed

to use 60 per cent of this for grazing studies on the mountain ranges of the region as a whole and 40 per cent for range research in the plains section, to be centered at the Fort Keogh Livestock Experiment Station, operated by the Bureau of Animal Industry at Miles City, Montana. The latter bureau conducts only animal husbandry experiments at this point.

The lack of definite knowledge of such matters as rate of timber depletion and replacement, the amount of remaining supplies, area in private and public ownership according to present and potential productivity calls for early extension to this region of forest survey. Really intelligent land use plans and policies cannot be evolved for the region until there has been a thorough inventory of resources. The District 1 administrative organization has found it necessary to carry out some work of this sort on a small scale during the last 5 years to meet its current needs. To conduct the necessary work on an adequate basis and as a part of the forest survey project for the country as a whole, an allotment of $25,000 is needed. This amount is indicated by preliminary discussions with the Branch of Research and the Director of the Forest Survey.

The District Office of Products is unable with its present limited funds to meet the regional needs for studies of wood waste prevention, new uses for forest products, better utilization in the woods and the mill, collection of data on amount and costs of lumber production, and studies of market and other economic conditions. The specific need is for another technical man on the utilization studies and for a statistician, with the necessary clerical-computer help, to give full time to the vast amount of statistical work of this office. In order adequately to handle the work expected of this useful branch of the Forest Service organization, an increase of $10,000 is needed.

Fire weather research by the Weather Bureau is badly needed as a step in improving forest fire control in this region, where the situation is perhaps worse than it is in any forest region of the country. An experienced fire-weather meteorologist has recently been assigned to the Spokane Office of the Weather Bureau, but other station work appears to require part of his time and to prevent his undertaking adequately the urgently needed analysis of lightning storm data and daily weather reports that have been provided by Forest Service observers for a number of years. The improvement of weather forecasts for the forested and mountainous sections of the region depends on such analysis. To make this work possible, an increase of $5,000 is desired.

Expansion of the regional research program along the lines here indicated may be covered entirely by the authorizations of the McSweeney-McNary Act. The recommended increases would come under the various sections of the Act as follows:

1. Fire protection studies, Section 2, $15,000.
2. Forest Management studies, Section 2, $15,000.
3. Grazing investigations, Section 7, $25,000.
4. Products studies, Section 8, $10,000.
5. Forest survey, Section 9, $25,000.
6. Fire weather studies (Weather Bureau), Section 6, $5,000.

The present Experiment Station allotment of $20,247 is prorated roughly as follows: Fire studies $7,000; forest management studies $11,000; and miscellaneous work $2,247. Increases of funds as outlined above are needed now, and it is urgently recommended that provision for them be made in the next appropriation estimates of the Forest Service with the view of the allotments becoming effective July 1, 1931.

Experimental Forests, Research Reserves, Wilderness Areas

The policy of the Forest Service in the selection and permanent designation of certain areas for the localization of research experiments, for the perpetuation of samples of virgin timber, and for the preservation of large areas of true wilderness is of interest not only to all forest agencies in this region, but also to many other classes of people in this and in other sections of the country. The projects aimed at these objectives are nation-wide in extent and definite progress is being made in them in the northern Rocky Mountain region.

With regard to experimental forests, the plan is to have three in western white pine type and one each in the lodgepole pine, western yellow pine and larch-fir types. These areas range from 5,000 to 6,000 acres in size and serve to localize sample plots and other permanent investigations in experimental and demonstration forestry. The Priest River area in white pine and the Bernice area in lodgepole already exist. The Coram area in larch-fir is approved by all who have seen it, including Assistant Forester Clapp and Major Kelley. The Little Trapper Creek area in yellow pine is still under consideration. Examination was made of proposed white pine areas on the Coeur d'Alene Forest in 1928 and on the Clearwater Forest in 1929. Four possibilities examined in these two Forests were not satisfactory. Additional search is to be made next summer for suitable areas on these two Forests to represent the central and southern portions of the white pine type.

Natural areas, or so-called research reserves, range from 100 to several hundred acres in size, and are intended to preserve for all time samples of virgin forest conditions in the various forest types. Logging, slash disposal, grazing, and other use by man, no matter how conservatively carried out, destroy or radically change the environment of the original fauna and flora, as well as the original character of the soil and the bacterial life in it. Setting aside of areas of sufficient size to preserve these natural conditions intact will be of untold value in the future. Nine such areas have been definitely or tentatively selected so far: five in western white pine, one in cedar and hemlock, one in western yellow pine, one in larch-fir, and one in lodgepole pine. With large areas of lodgepole pine to be preserved free from logging and grazing in both Glacier and Yellowstone National Parks, and with large bodies of Englemann spruce in the former Park, fewer research reserves for these forest types are needed elsewhere. Discussion at the Spokane Council Meeting, however, seemed to favor a liberal selection of natural areas, one man stating emphatically that we could not make a mistake in establishing several such areas in each forest type. Duplication of areas so as to anticipate loss by fire or other cause is one of the original objectives of the project.

The selection of natural areas and experimental forests is being handled by Assistant District Forester Koch of the Forest Management Office and Director Weidman of the Experiment Station. Additional areas are to be examined in the field this summer and reports on the areas so far selected will be prepared during the year. The importance of selecting and setting aside these areas in this region is realized, but progress in making definite recommendations to Washington for formal establishment of the areas is slow because travel to reconnoiter and run boundaries, etc., usually several trips, has so far been entirely incidental to other work.

The designation of large wilderness areas which may be retained in a primitive and undeveloped condition is recognized as a land use problem of great significance in this region. As yet, no permanent selections have been made, but the possibilities of the entire District have been roughly mapped and described, and comments called for from all those who are well informed and interested in the subject. This work is being handled by Assistant District Forester Wolff of the Office of Lands and is receiving very thorough consideration. It is expected that several permanent designations can be made within the present year.

Administrative Research

When the forest investigations conducted by the administrative organization in this District are examined carefully, it is obvious that a considerable volume of such work is under way, and that from a dozen to fifteen men are participating annually on several National Forests. Furthermore, such research by the field force has been purposely encouraged by the District Office of Management. The Office of Products has likewise utilized many field men in its woods and mill studies in such a way as to encourage the technical development of these men as well as benefiting by their assistance. Each year, likewise, the Experiment Station uses one or two administrative men on office work for a few months. All of the daily measurements of weather and inflammability at six duff hygrometer stations and nearly twenty weather stations, which are of as much value in research as in current use, are made by administrative officers who frequently compile their own data and study the results for indications of local usefulness. Twenty-six of the observers who take records at phenological stations are local forest officers. This project is directed by the Experiment Station. An example of constructive interest in research is furnished by one of the recent developments in the lightning study dealing with the manner of recording lightning strikes. This method was proposed and elaborated by Ranger Mendenhall and Supervisor Hornby of the Flathead Forest and is now in District-wide use in making the observations of this project.

The assignment of specific research projects, such as the maintenance of local thinning or methods-of-cutting sample plots, to field officers, is ordinarily impracticable under present conditions because of the impossibility of fitting such extra effort into the already overcrowded work plans. The present conditions, however, now and then permit temporary details to research, and this opportunity certainly should be grasped as frequently as possible so that technical development may be encouraged

faster than routine administrative practices would otherwise permit.

There is another side of this problem, however, which also deserves attention, and that is the contact and familiarity of research men with administrative work. In this connection Mr. W. W. White, in charge of personnel training in the District, recommends as follows: "Every five to ten years most research men should have a detail for a whole year to administrative work outside their own branch. In about the same way, Management men should be detailed to research. This would keep the research man's feet on the forest ground and keep the Management man's head a little above the daily routine." It seems probable that if a too-confined diet of routine administration needs relief and stimulation by some research work, just so too much pure research might profitably be salted with some administration. The periodicity and the length of the details are minor to the principal purpose and method.

Private Forestry Practice

Probably the two most outstanding developments in private forestry in this region during the past year have been the continued progress of the Clearwater Timber Company in its silvicultural marking practices and brush desposal, and the designation by the Potlatch Lumber Company of 46,000 acres of its cut-over lands as "reforestation lands" under Idaho's new reforestation law.

The Clearwater Timber Company is probably the only private operator in this region that both piles and burns its slash carefully and cuts by a selective method for an early return cut. In its 100-year-old timber comprising 75% of its holdings, it is cutting to a diameter limit of about 17 inches and leaving 25% of the original stand. There is no doubt but that this company is making a real investment in forestry on the lands now being logged, which are particularly suited to such a practice.

The Potlatch Company, by its application under the Idaho law, agrees to continue adequate protection on cut-over land for a minimum of 50 years, to abide by such reasonable rules as may be prescribed by the Forestry Board for the care, protection and development of commercial forests, and to permit grazing only under regulation designed to prevent damage to young growth. After these 46,000 acres are designated as "reforestation lands" the assessed valuation automatically becomes $1.00 per acre for 50 years, and when merchantable timber products are removed, a yield tax of 12½% will be applied.

PROJECTS UNDER WAY AND PLANNED

At the Spokane Council Meeting the following lines of research work were discussed in detail, each of the 106 projects being brought up for discussion as to its purpose, relative need, progress, and correlation with other projects by other agencies.

Artificial Reforestation

The subject of artificial reforestation received more attention at

the Council meeting this year than since planting research was discontinued in this District three years ago. While the discussion did not neglect the need of planting in this region, it concentrated more on the difference between planting enough trees to call the area reforested and planting properly so that a good quality crop could be expected as soon as possible. Mr. Olson stated that on Federal lands alone we have 300,000 acres of double burn in this region, which is increasing at the rate of 20,000 acres each year, whereas we are planting only 3500 acres annually at a cost of about $12 per acre. No figures were available to show the present total and the rate of increase of double burns on private and State land. Dean Miller pointed out that the University of Idaho survey of Benewah County shows that about half of that area, which has been heavily cut over and burned for the most part, is naturally restocking to a fairly satisfactory degree.

This precipitated a discussion of what constitutes satisfactory restocking, why 8x8 foot spacing is the standard for planting in this region, and what spacing is desirable to produce a good quality of timber. It was generally agreed that both number of trees and distribution are important factors in determining whether or not an area can be classed as restocked, but there was no clear agreement on the exact number or distribution. The selection of 8x8 spacing on the basis of the mere opinion of many foresters, both American and foreign, some 20 years ago, was not believed to be an acceptable reason for permanent continuation of this practice. The lack of knowledge of effects of spacing on growth rate and quality were emphasized, and Federal, university and private foresters all agreed upon the need for more detailed and more dependable knowledge on this forest problem.

In contrast with this need of knowledge, and in spite of the fact that a great number of projects have been successfully carried through by Forest Service planting research, there are at present only 8 projects under way. The greater relative importance of many other lines of research is indicated by the fact that only 1% of the research funds expended in this region are devoted to artificial reforestation.

Nursery Practice

The University of Montana School of Forestry has two projects under this head, one being restricted to methods of hastening the germination of 37 species of tree, shrub, and vine seeds, and one covering all of the local problems of the University nursery at Missoula, which is now stocked to ship about one million seedlings and transplants annually for distribution to farmers in the great plains section of eastern Montana under the Clarke-McNary Act. The stock is being supplied almost entirely for windbreak, farm-yard and wood-lot planting.

Although the Forest Service does not list any projects in nursery practice, a large amount of checking of the results of previous work is continually in progress, as described in detail in last year's report. This work is adding many new facts to the results of former work. The information being obtained from many of these checks also strongly indicates that the changing soil conditions at Savenac Nursery are creating new factors which may need intensive research in the near future.

Mr. Olson's bulletin on nursery practice, which has been highly commended by those who have read the manuscript, was reported as still in Washington awaiting publication. The desirability of early publication of this report was urged by the committee. Wahlenberg's report on "Investigations in Weed Control by Zinc Sulphate and Other Chemicals at the Savenac Forest Nursery" appeared in print as Technical Bulletin No. 156, in January, 1930.

Sowing and Planting

The University of Idaho School of Forestry hopes to conclude one of its three projects under this head during the present year. This is a study of the effects of windbreaks on the growth and yield of field and orchard crops in southern Idaho. Measurements have been made of the effects of these windbreaks both on meteorological conditions and on crop yields. The results are very favorable and are being used to prevent the removal of old windbreaks and to induce planting new ones.

The other two planting research projects by the University of Idaho are devoted to studies of forest and shade tree planting on alkali soils, and at the higher elevations in Idaho. In both cases the work is now beginning to indicate which species are best suited for these two planting sites. The tests include 20 species on alkali soils, and 17 species at high elevations. Naturally, examinations must be made for several years more before definite conclusions can be announced.

The single project carried by the Forest Service Office of Planting, studying the best species and methods of planting to obtain survival on grassy bottom lands, could not be touched during 1929 because of the demands of the fire season. Some work was done, however, on the effects of blackened and other soil surfaces as they affect soil temperatures and seedling survival. On one day when the air temperature was 87° F. the following soil temperatures were measured: red dust - 131°, black dust - 136°, small rock - 140°, yellow dust - 147° F. The cause of the maximum shown here was attributed not so much to the yellow color alone as to the fineness of texture, and to the depth of the layer at the spot measured. Surface soil temperatures become critical for young tree seedlings at 120° F., extended exposure at this temperature causing severe injury and sometimes death, whereas with soil temperatures as high as 140° F. a short exposure will kill seedlings. The Experiment Station has also made measurements of soil surface temperatures in connection with several of its projects, particularly the study of reproduction after forest fires.

The Experiment Station made a detailed topographic survey of its arboretum area last fall and is to follow this with a soil survey before putting its arboretum project on an actively enlarged basis. It is the plan to try out all exotic tree species that hold some promise of growing in northern Idaho. Plantations have been made at Savenac Nursery of several exotic conifers, as a test which seems worthwhile, though not defined as a research project. This type of work was commended by the Council and several other species were suggested as deserving trial planting in this region.

Seed Studies

The Office of Planting study of yield and germinative energy of western white pine seed from various age classes is the only project in this class at present. No work was possible during 1929, due to the character of the fire season. One field observation was reported, however, by Mr. Olson, which is related to this problem and which has a distinct bearing on the rate of restocking of burned areas. On several of the second and clean burns of 1910, white pine seedlings followed immediately from adjacent sources of seed supply. The important observation is that these new trees, some of which are only 17 years old, are now in turn beginning to bear seed which is carried by the wind farther and farther into the burn. This is Nature's way of regenerating devastated areas by the slow method of migration.

The Experiment Station has nothing new to report concerning the western yellow pine source of seed experiment for which a report was published in 1928.

Forest Influences

No research projects are listed by any agency in this region as devoted to the study of forest influences. As mentioned in last year's report, however, there is considerable work being done in the course of other projects which is producing records that are certain to be of value when this phase of forestry is studied more intensively. Not the least of these contributory projects is that by the University of Idaho devoted to a study of forest and shade tree windbreaks. This work already has produced measurements of the effects of small stands of trees on atmospheric and soil factors, and has undoubtedly produced as a by-product considerable information on the technique of making such measurements. As method is such an important factor in successful research, any project which results in more dependable and more comprehensive methods has a value regardless of its other contributions.

Forest Management

The estimated relative importance of studies of forest management in this region is indicated by the fact, shown in Table 1, that practically nine per cent of the research funds is expended on such investigations. Only protection and products projects are granted larger percentages. Of all the Forest Service research funds available in this region, however, 19½% is used on forest management studies. Work by the Experiment Station accounts for all but $400 of these latter costs, and comprises 42% of the Station expenses.

The need for much additional work in forest management was demonstrated at the Spokane Council Meeting, but the immediate urgency of faster progress in protection and products research was also recognized. The present work comprises nine projects, seven being carried by the Forest Service and two by the University of Montana.

Methods of Cutting

Assistant District Forester Koch described the present situation with regard to methods of cutting as follows:

"In spite of the considerable amount of research work which has been done, white pine silviculture is still to a large extent in the experimental stage, and the Forest Service is continually experimenting on a large scale in its timber sale operations. We know pretty well how to reproduce white pine, but a continual compromise is necessary between the best silviculture on the one hand, and on the other hand the cost of silvicultural measures and the low or negative value of the species in mixture with white pine. We are at present experimenting on timber sales with the idea of leaving for a future cut all or most of the sound mixed species. The indications are that this will work pretty well in stands not over 140 years of age, and particularly in white fir or Douglas fir mixture. The success of the operation from the standpoint of reproducing white pine will depend largely on the possibility of a second cut to remove the mixed species within the next twenty or thirty years.

"Another phase of the problem on which we have done a good deal of work on timber sales is the matter of disposing at a reasonable cost of the defective hemlock and white fir, which so often encumbers the ground and in extreme cases makes the growing of a satisfactory new crop of any species impossible. For the old and very defective stands, which are typical of the Kaniksu Forest, and which also occur in large areas on the Coeur d'Alene and Cabinet Forests, the most promising method seems to be to cut the white pine clean, fell all of the defective hemlock and broadcast-burn. Several large units are being treated in this manner. The Kaniksu Forest is contracting felling of the hemlock in such stands for $17 to $23 per acre. With an average cut of 20 M per acre of white pine, the piling and burning of the slash would cost close to $20 per acre. Consequently the job of getting rid of the defective hemlock is costing from nothing up to $10 per acre. Several large units have been successfully burned.

"One of the things on which we most need further research is the rate of growth after cutting on mixed species and white pine in those stands which are not cut clean. In typical 120 to 160-year-old stands there are many white pine trees 10 to 16 inches in diameter which are tall and spindly and do not make good seed trees. With the higher cost of logging such trees it is a question to what extent we should leave them. If they will not grow appreciably they should be cut now if there is anything in them at all. Further study in this line is much needed both by the Forest Service and by companies such as the Clearwater Timber Company who are doing selective logging."

By contrast with these Federal Forest problems, Mr. Billings, of the Clearwater Timber Company, stated that his company considers methods of cutting practices designed to control future species and quality as secondary to silvicultural measures designed to insure better protection from fire. This company prefers to cut the timber and dispose of the brush in such a way that each area will be most surely protected from fire, disregarding for the present the future growth of the residual stand

if its control interferes with protection from fire. This applies to the old overmature timber comprising about 25 per cent of their holdings. In their young timber, the remaining stands the company is leaving cannot help but make good growth for a return cut in 25 to 30 years.

The investigations under way to solve the methods-of-cutting problems just mentioned consist of an intensively conducted project by the Experiment Station employing a number of permanent sample plots trying out and checking up on different methods and the results that are being obtained. Twenty-one per cent of the Station's effort is being devoted to a study of increment after cutting in residual trees on timber sale areas in the white pine, western yellow pine, and lodgepole pine types. This office is able to devote only about 3 or 4 man-weeks to these projects each year. The Experiment Station has completed several years of field work studying reproduction and the growth of remaining trees on old Government and private cuttings in the white pine type. The preliminary results were made available in an advance report sent to interested Forests and private agencies. A final report is in preparation.

During the past year six new methods of cutting plots were established on the Coeur d'Alene Forest by the Experiment Station, thereby bringing the total number of permanent plots of this type up to 18. Four of these new plots were installed to determine best methods of opening up the overwood to produce both satisfactory white pine reproduction and good growth of the residual stand; one was made to show what happens when the hemlock understory is left untouched; and one was located on a severe south slope to determine how much shade must be left to assist white pine establishment under such conditions. On these plots 185 small quadrats were established for the purpose of intensively recording each year the germination, mortality and survival of seedlings with a view to learning by exact observation what results in the way of restocking are secured by the different methods of cutting.

Natural Reproduction

The Experiment Station has one of its major projects under this head. It comprises 13 permanent sample plots containing 602 screened and unscreened reproduction quadrats. As the methods-of-cutting plots also contain reproduction quadrats established for a slightly different purpose, there are altogether 1,250 of these small intensively observed units which come up for examination each year. Most of these have run three years now and are beginning to yield definite and fundamental facts on production, dissemination and storage of seed, as well as germination and establishment of seedlings. Shortly these experiments will tell us what our sources of seed should be under different conditions, whether we can in some cases depend on seed accumulated in the duff or whether we must have seed trees and what should be their size, number and distribution. What we know now is based on trial and error and is obviously incomplete.

Brush Disposal

Although the disposal of logging slash on private and public land

is a forestry practice of extreme importance in this region, from the standpoint both of protection and of keeping cut-over land productive, only one research project is being devoted to the problem at present. This study is being carried on in the western white pine type by the University of Idaho and is taking the full time of one member of its research staff. The plan for this investigation covers methods, costs and policies of slash disposal. Most of the work to date has been devoted to an improvement of a commercial torch so that wetter slash can be ignited more quickly, thereby extending the safe burning season and reducing the costs. Four experimental plots have also been used to study the elements of cost of different methods of brush disposal. This research has been under way for two years.

Thinning

Very little time was given at Spokane to a discussion of this phase of research work, although the fact was stressed that the future demand for forest products is going to fall on second growth stands much sooner than most people think, and that much of these products will very likely be harvested by thinnings rather than by final cuttings. As results of different thinning methods vary considerably, and as experiments to determine the best methods require long periods of time, it is important that a more adequate number of experiments be started at an early date.

At present there are in this region one series of thinning tests in progress on the Custer Forest in the western yellow pine type, and one series in western white pine on the Kaniksu Forest. Six plots have been used on the Custer Forest since 1921 and remeasurements are planned at the expiration of ten years. Eleven white pine plots have been established on the Kaniksu Forest and four which are now 15 years old, and four which are 10 years old, were remeasured during the past fall. A progress report is planned for preparation during the present year.

The University of Montana has recently commenced a new study of the possibilities of cheaply thinning an overdense stand of sapling growth by use of a power tractor. No information is available as to in what condition this method will leave the remaining stand.

Mensuration

Twelve projects were listed under this head at the Spokane meeting. Five of these are carried by the Experiment Station, one by the Office of Management, and three each by the forest schools of Idaho and Montana.

Volume, Growth, and Yield

Of the five Experiment Station projects, those devoted to larch and Douglas fir yield plots, to converting factors, and to regional growth and yield data, are continuing projects requiring only incidental or periodic attention. The white pine yield study which produced the present normal yield tables of northern Idaho has been until recently a

major Experiment Station project. A preliminary report making available all the tables, both yield and second growth volume tables, was gotten out in mimeograph form several years ago. A final report for departmental publication going into the details of the subjects is being prepared this winter. No recent work has been possible in the Office of Management project for the construction of volume tables for Douglas fir in eastern Montana.

Of the three projects carried by the University of Idaho, the one devoted to the growth of residual stands of western red cedar has been dormant during 1929. Considerable progress was made, however, on the project dealing with the effect of release by logging on the growth and form of residual trees in the western white pine type. A final report is expected and the project should be closed during the present year. The third project on form, growth and yield of residual western yellow pine stands is in the compilation stage, with completion indefinite.

The work of the University of Montana deals chiefly with the remeasurement of several permanent plots with the ultimate object of making a western yellow pine yield table. Remeasurements are due in 1931. No further work has been possible on the project devoted to the empirical use of the form quotient for cruising timber as elaborated by Professor Clark.

In the discussion of the work planned but unexecuted on mensuration projects there was general agreement by all agencies involved that too often the tendency to do field work is not balanced by the necessary capacity to keep up the office compilation. In one case, field work has been stopped and the investigator permitted to spend the summer months on compilation so that balanced progress may be made. This seems to be the best possibility available whenever funds are lacking for concentration on the office work.

The need for information on the application of normal yield tables in the white pine type, for growth and yield data applying to the fir-larch type where half the Montana lumber cut is concentrated, and for data on yields over large areas in all types for use in damage cases, was pointed out. The impossibility of attacking these problems without additional funds, or the elimination of other much needed work, was appreciated.

Protection

The paramount importance of forest protection in the northern Rocky Mountain region, and the recognized need of improving all protection practices, are shown by the fact that two-thirds of the research funds expended in this section were devoted during 1929 to investigations of possibilities of better protection. Of the total funds used for such studies, the Bureau of Plant Industry contributed 63% through its Spokane Office of Blister Rust Control; the Bureau of Entomology contributed 16% through its Coeur d'Alene field station; the Forest Service added 7½% through the D-1 Office of Operation and 6½% through the Experiment Station;

the Weather Bureau expended 4%; and the University of Idaho 3%.

It was universally recognized at the Spokane meeting that the importance of successful blister rust control and the complexity of the problem, fully warrant the present expenditures for research in this field. The widespread extent of entomological problems and their diversity likewise demand the funds going into this work.

In striking contrast to these expenditures is the small amount of funds available to the Forest Service for research in fire protection in this region, generally conceded to be one of the most dangerous from the standpoint of forest fire in the country. A more detailed examination of each of the departments of forest protection indicates that the Forest Service, as the largest forest land owner, is not doing its proportionate share of the research work that is needed in order to save from destruction the forest resources of the region. The obvious need is an adequate increase of funds for the Northern Rocky Mountain Forest Experiment Station, as authorized, but not yet appropriated under the McSweeney-McNary Act.

Diseases (Blister Rust)

In last year's report of the Investigative Council Meeting, mention was made of the discovery during 1928 of one center of blister rust infection on western white pine in this region. Since then four more centers have been found, and more are anticipated. In view of the devastating character of this disease on white pine, and the exceptionally high value of that tree species in this region, Mr. Wyckoff's report, which follows, and his estimate of the funds available for blister rust research are of exceptional interest.

"Investigative and experimental work being carried on by the Office of Blister Rust Control centers around two general lines of investigation, (1) further development and improvement of Ribes eradication methods, and (2) field studies of the rust.

"The decision to undertake Ribes eradication in the stream type as the initial step in the general control program has resulted in an immediate drive upon improvement of methods of chemical eradication. This necessarily includes studies of the chemicals themselves, the equipment used in their application, and the method of using the equipment. The duration of such work is indefinite. It will be continued until the possibilities of bettering control methods are practically exhausted.

"Studies of rust are designed to secure information regarding its rate of advance and intensification through the white pine belt and its results secured by control measures in affording protection to pine stands. The former project gives information necessary for planning control operations. The latter is of great importance in determining the effectiveness of a control method known from experience and technical study to be sound, but which must now be applied to a region in which the effect of weather conditions and new hosts has not been previously evaluated. The duration of this work is indefinite.

"The projects under these two general lines of investigation are as follows:

1. Further development and improvement of Ribes eradication methods.

   a. Development of toxic chemicals for Ribes eradication.
   b. Methods of chemical eradication of Ribes.
   c. Re-eradication of Ribes.
   d. Studies of ecology of Ribes.

2. Field studies of the rust.

   a. Determination of rate and direction of spread of the rust.
   b. Determination of effectiveness of control."

Co-operating with the Spokane Office of Blister Rust Control, the University of Idaho is conducting two projects devoted to the factors affecting the germination of Ribes seeds, and the methods of logging and brush disposal that favor control of blister rust. A report on the latter work was published in the Journal of Forestry, Volume 26, pages 892-898, in 1928.

Diseases (Rot Producing)

The single project, described in last year's report, devoted to the causes, visible signs, and rate of spread of heartrots in hemlock and white fir, is the only research of this type under way in the Northern Rocky Mountain region. This is a co-operative project, between the Forest Service and the University of Idaho, and considerable compilation work remains to be done before it can be completed.

Fire

The 1929 fire season supplied abundant proof of the possibilities of research assisting in many phases of fire control in this region. As one result, aggressive action has recently been taken to obtain the funds long recognized as necessary for the construction of essential physical improvements, and for additional personnel on the National Forests. When these needs are cared for, however, the demand for the most efficient daily use of these facilities is certain to be a paramount issue. Then the need will be more obvious for improving methods, such as those involving thoroughly dependable weather forecasts, measurements of prevailing inflammability, intensive accounting for lightning storms and strikes, the distribution and most efficient use of the protection force, measures leading to reduction in elapsed time of both discovery and attack on fires, extremely intensive fire prevention, tactics and tools of suppression, and many other means and processes which depend more upon skill than upon mass effort. These matters have been given particular attention since last summer and further thought on the subject by the District Forester and Experiment Station since the Council meeting is leading to

proposals that will shortly be made by letter to Washington.

The single fire research project upon which the most funds were expended in 1929 in this region is one devoted to the development of portable radio telephones for forest use. This work is being done by Forest Inspector D. L. Beatty, of the District 1 Office of Operation, a qualified expert in radio telephony, who is making use of the most scientific advice obtainable, both from the Bureau of Standards and from the commercial radio companies. The work has progressed to the stage in which extensive field tests are to be made during 1930. The weight of the portable sending and receiving set has been reduced to a very satisfactory limit, but the selection and control of the most efficient wave-length seems to be the most difficult problem at present. Mr. Beatty is giving his full time to this work, and success is certain to be a contribution of incalculable value to fire control throughout the entire country.

Additional experimental work on equipment by the District 1 Office of Operation includes tests and improvements of explosives for fire trench construction, and the improvement of small walking tractors for the same purpose. Another line of work is aerial photographic mapping, a field in which Mr. H. R. Flint, in charge of fire control, has been a pioneer in the Forest Service. The primary purpose of these tests is the development of cheaper and better methods of making fire control maps. About 470 square miles have been photographed to date, and the maps partly compiled with very encouraging accuracy and costs. The work done so far has been incidental to the District 1 air patrol during fire seasons. In addition to these two major and two minor projects, the Operation Office has had a study of adequate fire control in progress for two years. The purpose of this work is to define adequate fire control for the region, from an economic standpoint, and to devise suitable written plans to direct its actual achievement on the National Forests. Mr. Flint is also investigating from office records the relation of lightning fires to the underlying geological formations to determine whether or not certain mineral-bearing areas experience greater danger than non-mineral lands. Very little time is available for this work.

Fire studies by the Experiment Station, which utilized 26% of the Station funds, covered a more restricted field, and were more poorly financed than the administrative research just described. The original selections of the three projects carried by the Experiment Station were made on the basis of both research and administrative experience prior to 1922. Although each of these lines of work is still rated as essentially important, other phases of the fire control problem probably have grown in importance, temporarily if not fundamentally. Of these three projects, that devoted to lightning storms and fires has been the most productive of immediately useable results; that devoted to the controls of forest combustion, especially the effects of the weather inflammability, has been the most complicated and the most fundamental; while the co-operative work with the U. S. Weather Bureau in improving the daily weather forecasts for the forest areas has required the least effort in proportion to the success attained.

The study of lightning storms and fires has been described in

detail in past reports. During the past year the principal progress by the Experiment Station was made in compiling and analyzing 14,754 observations of storms in this region during the period 1924 and 1928, inclusive. The results of this analysis both correct and amplify previous meteorological records and knowledge of lightning storms in this region. In this study the number of observation stations used, ranging from about 125 in 1922 to 344 in 1929, and their exceptional location largely on mountain tops, have permitted what is probably the most intensive record of storm occurrence, movement, and characteristics ever made over such a large area of mountainous country.

The chief value of this work to the Forest Service has been the improved protection from lightning fires, and it is altogether probable that even yet full value is not being obtained. The improvements in protection have resulted from increased surveillance of and attention to lightning storms and fires, from knowledge of how the fire-starting type of storm can be distinguished from the generally safe type even before any fires are discovered, and from more accurate 36-hour forecasts of storm occurrence by the Weather Bureau on the basis of these new and more accurate records.

As no meteorological phenomenon can be completely accounted for in such a short period as five or even ten years, this work is to be continued. The work to date, however, has resulted in the accumulation of records faster than the Spokane Office of the Weather Bureau has been able to study them for their meteorological significance. Consequently it is decidedly essential that the facilities of that office be increased in such a way as to permit the much needed progress which can be made in forecasting, by the study of these lightning storm reports. As this study is already four years behind in the use of current data; as all forest protective agencies are clamoring for better forecasts especially of lightning storms; and as the accumulation of future data will probably be at the rate of from 3,000 to 4,500 reports each year, immediate action is eminently desirable.

The second fire research project by the Experiment Station, which is the most fundamental of the three, and which ultimately probably will prove to be of the most value in fire control, is devoted to the processes of combustion of all the various forest materials that burn in a forest fire and the factors that control this combustion. Although the effort so far expended on this work has been relatively small, the technique, methods, and the duff hygrometer which has been developed in the course of the work, have been adopted in the several other regions throughout the country where fundamental fire studies have more recently been started. Of equal importance, the National Forests in this region, having tested the methods of measuring forest inflammability and other criteria of prevailing fire danger, are each year coming to pay more attention to these results of research in the daily work of fire prevention and control.

The third project carried by the Station has been very valuable in improving the weather forecasts for this region. By far the major part of the routine work is done by the various Forests which assist by making daily weather measurements and reports. Without detailed and

accurate reports from a completely representative network of field stations it is obviously impossible for the Weather Bureau meteorologists to prepare localized and accurate weather forecasts. A big improvement in the quality of the forecasts has been made in the last few years largely as a result of the Forest Service field station reports. This is more than sufficient warrant for the establishment of many more stations to fill the existing gaps. The Experiment Station work is confined to liaison between the Weather Bureau and the Forest Service, including the installation of stations and their inspection to insure accurate measurements and reports.

At present the Spokane office of the Weather Bureau is carrying only two research projects, one devoted to thunderstorm predictions, and one to relative humidity and vapor pressure conditions throughout the region. Both of these are fundamental to improved fire control, yet no great amount of real research work has been possible on either one, because of the press of other work at that station. It has been possible so far to compile the lightning storm reports for only one year, 1928, and these records have not yet been fully analyzed to ascertain their significance in localized forecasting. The reports for five other years have not been touched. Furthermore, no work has as yet been possible in subdividing the region into local forecast districts--a most fundamental procedure; and no time has been available for studying rainfall, temperature, and wind differences in the different forested sections of the region and under various conditions of high and low barometric pressure, or weather types. The assignment of Mr. F. C. Crombie, an experienced fire-weather meteorologist, to this work was welcomed by the Council, but it was recognized that the volume of material on hand and accumulating currently will require even more than his full time for proper compilation and analysis. It is understood that it is not possible for him to give his entire time to fire weather work. The Investigative Council unanimously urged action which will permit the Spokane office of the Bureau to study both the lightning storm and daily weather reports in detail so that the forecasts may be improved accordingly.

Insects

During the past few years insect depredations have become more and more serious in the northern Rocky Mountain region. Large sums of money have been expended in control measures, but the many problems of cheapest and most successful control have not yet been solved. Consequently, Mr. J.C. Evenden's statement of the work of the Coeur d'Alene Forest Insect Field Station, which follows, is of greater than usual interest this year.

"The following projects comprise the investigative program of the Coeur d'Alene Station of the Bureau of Entomology. Several of these projects are not carried as major lines of activity and the time which is devoted to them is only secured before or after the regular field season, or at odd times during the summer. A list of these projects follows:

1. Biology and artificial control of Dendroctonus monticolae in lodgepole pine.

2. Biology and artificial control of Dendroctonus monticolae in white pine.

3. Parasites and predators of Dendroctonus monticolae.

4. Environmental factors influencing the destruction of barkbeetle broods liberated by peeling.

5. Maintenance control of endemic Dendroctonus monticolae infestations in white pine.

6. Barkbeetle control.

7. Role of insectivorous birds in relation to the flight mortality of barkbeetles.

8. Insects and forest fires.

9. Biology and control of spruce budworm.

10. Biology and control of fir tussock moth.

11. Injury to Douglas fir, Gallatin National Forest.

12. Ecology of timber types following insect epidemics.

13. Winter killing of yellow pine foliage.

"The destruction of merchantable timber by barkbeetles of the genus Dendroctonus constitutes the most serious entomological problem in the protection of our Idaho and Montana forests which confronts us at this time. The economic pressure of this problem has resulted in practically the entire investigative force of the Coeur d'Alene Station being concentrated upon it.

"Though direct control measures have been developed, and used for years in the combating of barkbeetle outbreaks, they are not entirely satisfactory. To overcome the objections of these methods an intensive study of the mountain pine beetle in its relation to the destruction of lodgepole pine has been conducted for the past four years. This study has as its objective the development of more effective and less expensive means of combating and preventing such destructive outbreaks as we are now experiencing. In the prosecution of this study it was necessary to consider such phases of the problem as the seasonal history of the insect responsible for the destruction, its relation to the beneficial parasitic and predacious insects found in association with it, the role of insectivorous birds, the relation of climatic conditions to insect development, the reaction of the insect to certain external stimuli, the physiological and chemical properties of the host trees being killed--in fact a complete understanding of the insect in its relation to the many variable factors encountered within the environment was sought.

"In the prevention of insect depredations within our forests it

must be remembered that when once a tree has been successfully attacked by barkbeetles it is impossible to save the life of that tree. Control measures are therefore directed towards the destruction of the insect broods within the infested trees in order to prevent their emergence and subsequent attack of other trees. A method of control has been sought which would not only be less expensive in its application, but would be capable of taking full advantage of the potential benefits to be secured from parasitic and predacious insects. Methods of control are now in use which permit us to treat an infested lodgepole pine tree for a relatively low figure. The objection to these methods lies in the fact that rather large crew organizations are necessary for their administration, requiring excessive overhead, transportation, and subsistence costs. To overcome these objections a method of control must be developed which will not only have the qualifications just mentioned but will permit of a large production per man day. With such a method of control a smaller crew organization could be used, reducing transportation, subsistence, and overhead, in which items the excessive costs of our projects seem to lie.

"The first work in connection with this problem was directed towards the development of a method of control for the suppression of Dendroctonus monticolae outbreaks in lodgepole pine. The severe outbreak of this insect on the East Fork of the Bitterroot River offered a favorable location for this study, which was instituted in 1926.

"Hoping that abnormal moisture conditions could be created within the newly-attacked trees which would prove to be detrimental to the development of Dendroctonus broods, a series of trees were treated in various ways so as to either secure or prevent evaporation. These trees were treated early in the fall, soon after the attacks had occurred. Though before the time of emergence very abnormal moisture conditions were created, there was little detrimental effect upon the developing broods.

"The idea of using the old, overmature, decadent trees of a stand as traps into which the insects might be drawn for subsequent treatment offered a variation to our present method of control which could be used to advantage in certain types of infestations. With this idea in mind a series of trees were treated in different ways in an attempt to make them attractive to the attacking beetles. Though some of these treatments did seem to exert some influence upon the insects, untreated trees adjacent to the trap were often attacked in preference to those treated.

"The possibility of injecting infested trees with a toxic solution in order to destroy the broods beneath the bark has been very thoroughly tested during the past three years. Though several solutions were developed which were effective in destroying the insect broods between the bark and wood, the difficulties of the problem were found to lie in the technic of application. Through the use of stains it was found that the diffusion of the liquid was perpendicular above the point of injection with very little lateral spread. This physiological fact called for the development of some form of applying the poisonous solution so that it would come in contact with the cambium layers around the entire circumference of the bole. Though this has been accomplished in the field, with very satisfactory results, a technic has not been developed

which would be economical in its application. This phase of the problem now calls for the development of some economical form of applying these solutions to the trees. During the coming season additional tests of various methods will be conducted.

"To secure a better understanding of the importance of the insects found in association with Dendroctonus monticolae in lodgepole pine, a thorough study of this phase of the problem was started during the 1928 season. Seasonal histories and habits of a large number of insects have been determined, contributing valuable data towards a better realization of the relationship which these insects bear towards the primary insect. The correlation of artificial control measures with the seasonal history of the most beneficial parasitic insect offers an opportunity to take advantage of this natural agency of control in combating future epidemics. To secure this advantage control measures should be conducted in the fall of the year, or completed by the first of June.

"The role which certain insectivorous birds play in the destruction of Dendroctonus monticolae broods has been very thoroughly studied during the past two seasons. Under State and Federal permits, and in cooperation with the Bureau of Biological Survey, a number of these birds have been taken and an analysis made of their stomach and gullet contents. The result of this study has demonstrated very clearly that the role which these birds play in the protection of our forests is indeed an important one, and emphasizes the need for offering to this agency the best protection and living conditions possible.

"To determine the future of immature stages of barkbeetle broods liberated and exposed following the practice of peeling the bark from the trunk of infested trees as a means of control, an intensive study of this phase of the problem was started during the 1928 season. It was found that, when protected, pupae and mature larvae would often continue to develop until a mature adult stage was reached. However, it was also found that when such broods were liberated in lodgepole pine stands they were very quickly destroyed by ants, and by small rodents in white pine forests.

"All control projects for the suppression of barkbeetle outbreaks have been and are still being regarded in the light of experiments, with the idea of improving the application of control methods now in use. From the study of these projects valuable data relative to the flight habits of Dendroctonus monticolae, benefits to be expected from control, development of proper organization and supervision for control projects, etc., have been secured.

"In summarizing the progress accomplished during the study of this problem, it would seem that the results have for the most part been somewhat negative in character. However, information has been secured which is not only proving to be of constant value to us, but it has resulted in establishing the negative value of many suggested lines of procedure. Improvements are being made in our present methods of control which have greatly increased the efficiency of the work and reduced the cost of operation. The most outstanding of these improvements is the

method of treating the standing infested tree which has been developed within the forests of District 4, and the fall treatment of white pine by burning, which was instituted last season on the Kootenai Forest. Though no startling positive results have been secured, it is sincerely felt that satisfactory progress has been made.

"Further study of this problem in its relation to lodgepole pine has been temporarily discontinued and a similar fundamental study is to be instituted within the white pine stands of northern Idaho. The reason for this discontinuance, without a satisfactory solution, is that the work has reached a point where the assistance of plant physiologists anc chemists must be secured before further work can be planned. As such preliminary work is now being conducted at the California station of the Bureau of Entomology, the work in this region has been discontinued until a fundamental groundwork has been established. Any promising leads developed within the California region will be promptly tested within this district.

"A very encouraging start has been made in securing information contributing towards a better understanding of the relationship existing between the injury to forest trees by fire and their subsequent death. A sample plot established by the Experiment Station on the Kaniksu Forest has been utilized to secure preliminary data on the white pine phase of this project. A small 1928 burn in yellow pine near Coeur d'Alene, Idaho, is being intensively followed in studying the yellow pine phase of this relationship. Though the work has not progressed sufficiently to form a basis for any final conclusions, the data secured would seem to indicate that in most cases the fire is directly responsible for the death of the tree, and that the subsequent insect attack which so often occurs is purely secondary. It would seem that there is a direct correlation between the per cent of the root collar which is injured by fire and the death of the tree. Severe ground fires often cause the death of trees through the destruction of the root collar, when no injury to the upper bole or crown exists. This is especially true of white pine as it is more susceptible to fire injury.

"During the past season the problems of forest defoliation existing within this district have been given the attention which their importance warrants. Mr. R. E. Balch was assigned to the study of these problems and his entire time has been devoted to them. Early in the season an inspection was made of the airplane dusting experiment which was being conducted by the Canadian Government for the control of the spruce budworm. The remainder of the summer was spent in the study of the spruce budworm epidemics in the Yellowstone National Park and Cody Canyon; the fir tussock moth in central Idaho and Nevada; and the defoliation of the Douglas fir in the Gallatin National Forest. Last spring an experimental test of spraying for the control of the spruce budworm in Douglas fir was instituted in the Cody Canyon. Though the equipment which was used was not at all satisfactory, the data secured would seem to indicate that the feeding larvae can be destroyed through the application of a stomach poison. A more thorough test, with satisfactory equipment, is planned for the coming season.

"Preliminary dusting and spraying tests for the control of the spruce budworm in lodgepole pine indicate that the destruction of the larvae while feeding on this host will be a far more difficult task. The larvae feed at the extreme base of the needles which makes the effective application of a poison dust or spray to their food a difficult procedure. However, further tests are necessary in order to accurately determine the possibilities of controlling such outbreaks.

"Some field and considerable laboratory work has been conducted in relation to the fir tussock moth, and considerable biological data secured. In several areas the insect has been very heavily parasitized, and it is believed that this will bring the outbreak to a close. Considerable more work will be necessary in continuing this project.

"A combination of factors were found to be responsible for the defoliation of the Douglas fir in the Callatin National Forest. Data secured would seem to indicate that the Douglas fir needle cast fungus (Rhabdocline pseudotsugae), an aphid (Adelges cooleyi), and a spider mite (Oligonychus americanus), were all associated in the responsibility for this defoliation, and that considerable more work would be necessary in order to definitely straighten out the relationship.

Forest Products

The continued need of research in forest products and utilization and the excellent character of the investigations under way in this region were both brought out very emphatically at the Spokane Council Meeting. Mr. Billings stated, for the Clearwater Timber Company, that there are numerous and important problems peculiar to each operator, however, and that this company has a man engaged in such research. Mr. Bruce commented favorably on work being done by all agencies, and offered certain recommendations: 1. That studies be shaped with more emphasis on the lumber tally content of logs rather than on the log scale. 2. That publication should show the results by individual mills to bring out certain features which are obscured when the data from many mills or operations are combined. 3. That the effects of defect and decay should be included, as well as a sorting of data made for sound logs only.

In the course of the discussion of forest products research, the fact was admitted that some of the routine work of assembling statistical data is largely administrative in character. The correlation of such material, however, and the deduction of conclusions is decidedly research work. One such project is the proposed revision of both the Montana and Idaho Forest and Timber Handbooks, which were published in 1926 and 1927, respectively. More detailed and more accurate data are now available and can be prepared in more useable form than those published by the Bureau of Census. This revision is contemplated for some time after July, 1931.

The work of the District 1 Office of Forest Products centers around two general lines of investigations (1) Research in Forest Products and (2) Economic and Statistical Studies.

The projects under these two general lines of investigations are

as follows:

(1) RP - Products Research

a. Woods Waste Survey and Utilization Studies
b. Logging-Milling Studies
c. Preservation Studies
d. Little-Used Species - Properties and Use Bulletin
e. Sawmill & Depreciation Studies
f. Logging Output Studies

(2) RE - Economic and Statistical Studies

a. Lumber Production Census
b. Prices of Forest Products
c. Timber Survey of Private Lands
d. Logging and Manufacturing Costs

The funds spent by the District 1 Office of Products during the calendar year 1929 were proportioned between the two general lines of investigative work as follows:

(1)	Products Research	70% or $11,480.
(2)	Economic & Statistical Studies	30% or 4,835.
		$16,315.

The above amount includes the contributed time (in salary and expenses) of Forest officers, not members of the Products Office, who were detailed on active projects.

The Products work in the District (Forest Service) will continue along the lines stated above during 1930. The amount expended will exceed the 1929 expenditures by some $800. This increase in funds for expenditure in 1930 was made available during the past season by the detail of Products men on fire-fighting assignments.

RP - Lumbering-Logging - Milling Studies - Bradner and Anderson

The object of such studies is to determine the costs of production and the value of the products from individual trees of different diameters and species. Such information is necessary as a basis for a more profitable method of selective logging, to furnish basic data for use in private forestry and to enable a fair determination of the value in standing timber.

Field studies were completed during the 1928 field season on three areas in the western yellow pine type in co-operation with two different lumber companies and the Forest Service Office of Logging Engineering. Data on two of the areas have been compiled and analyzed for presentation to the co-operators and other interested lumbermen. The information on the value and yield of lumber from the different logs in the

various western yellow pine tree diameters was furnished one logging superintendent and is being used as a rough basis for selective logging of logs as well as trees.

There is an urgent need for similar data for young stands of Idaho white pine. More detailed information concerning the effect of various methods of cutting upon the net return per acre, or per thousand feet logged, is needed in the 80 to 120-year-old stand of western white pine. To do full justice to such a study the co-operation of the University of Idaho, the Northern Rocky Mountain Experiment Station, and a representative white pine operator are essential. It is hoped to plan such a study for the field season of 1930. Work on the data obtained on the three studies in western yellow pine will be completed and reports published.

RP - Wood Utilization Studies - Anderson

Following is a resume of the status of all projects started under this study:

Woods Waste Inventory

Type	Field Work	Office Work	Presentation
W.P.	Complete	75% Complete	None
Y.P.	"	75% "	"
L.P.P.	30% "	20% "	"
L.D.F.	None	None	"
		Breakage	
W.P.	30% "	20% "	"
Y.P.	"	75% "	"
L.D.F.	None	None	"
		Chute Depreciation	
W.P.	Complete	Complete	"

The results of the W.P. and Y.P. woods waste inventory will be published as trade journal articles before May 1, 1930. The results of the Gravity Chute Log Depreciation study will be published as a trade journal article sometime before March 1, 1930; while presentation of the Breakage study will be delayed until sometime during the winter of 1931, when a trade journal article covering all three types studied will be prepared. Office memoranda covering those portions of the above studies not covered in the trade journal articles will be prepared for the files.

To date 88 acres have been tallied in the white pine type for the waste inventory, 89 acres for the yellow pine type and 5 acres each in the larch-Douglas fir, and lodgepole pine types.

Approximately 3,000 Y.P. trees were scaled to complete the breakage study in the yellow pine type and 628 trees have been scaled to date in the white pine study. Measurements on 2,200 additional trees will be necessary in the W.P. type and about 1,200 trees in the L. D. F. type.

If circumstances are favorable field work for a log bucking for grade study will be carried on in the yellow pine type during the coming field season. A field assistant was employed who worked until September 1. From then until November 10 about 40% of one man's time was spent in the field. During the 1929 field season one man was in the field about 3 weeks during the winter supervising work on the breakage study. Four detailed Forest officers were engaged in this work for a total of approximately 80 man-days. A field assistant was employed for only 6 weeks during the summer, the balance of his time being on fire. One man spent about three weeks at the Madison Laboratory carding and sorting the breakage data in the yellow pine breakage study.

Woods Waste Inventory

Field		Office
Y.P. type	Complete	75% Complete
W.P. "	"	75% "
L.P.P."	30% "	20% "
L.D.F."	None	None

Breakage Study

Field		Office
Y.P. type	Complete	75% Complete
W.P. "	30% "	20% "
L.D.F."	None	None

The chute depreciation study was made at the J. Neils Lumber Company, Libby, Montana, and has been completed.

RP - Little-Used Species Project L-264 - Bradner and Whitney

The object of this project is to prepare or assist in preparing bulletins to furnish detailed information on the properties and characteristics of the wood of several of the District's little-used species which will assist consumers in determining suitability of the species for specific uses. Generally it is intended to promote the good utilization of such species, thereby increasing the economic value of this source of our present and future timber supply.

The District has selected three species, western larch, white fir, and lodgepole pine, for study. In 1926 reports were prepared bringing together all the available data on the western larch and white fir problems within the District. District 5 is co-operating with the Laboratory in preparing for publication the properties and use bulletin on white fir. Bradner of the District 1 Products Office and R.P.A. Johnson of the Laboratory were assigned as co-authors to prepare the properties and use bulletin for western larch. Whitney of the District 1 Office of Products is preparing the lodgepole pine bulletin.

The final manuscript of the western larch bulletin was prepared by Bradner and Johnson in the fall of 1929. Final edit and publication is expected in 1930. Preparation of the lodgepole pine manuscript will be completed, if possible, in 1930.

RP - Wood Preservation - Durability of Woods in Service - Whitney

Service Test Inspections - During 1929 six of the service test projects were inspected. This number includes five of the installations listed in the regular program and one special project not scheduled for examination in 1929. This additional project involved the collection of installation and identification data for 1800 ties in a test track at Missoula, Montana, in co-operation with the Northern Pacific Railway Company and the Forest Products Laboratory. Considerable rechecking was required in order to establish the identity of all ties in this track, which includes 1023 western hemlock and 777 ties of other species laid in 1910.

Treatment of pole stubs in a new service-test on the Absaroka Forest using Anaconda Wood Preservative was completed in August, 1929. Open-tank treatment of all creosoted stubs to be alternated with arsenic-treated stubs in 6 to 7 miles of line on the Gallatin Forest was completed and part of the stubs were set. The proposed pole stubbing project on the Beaverhead Forest, for which a supply of Anaconda Wood Preservative was purchased in 1926, has been dropped.

The results of an experiment with pitch-treated lodgepole pine poles on the Beaverhead Forest were summarized in November, 1929, by R.M. Wirka of the Forest Products Laboratory, and C. N. Whitney in an article entitled, "Pitch-Treated Lodgepole Pine Poles Did Not Give Long Life." It is proposed to publish this article under joint authorship in Telephone Engineer and other technical journals.

It is expected that service data on the experimental posts at Miles City, Montana, furnished in Whitney's 1929 report will be used in a paper on fence posts to be presented by R.M. Wirka at the annual meeting of the American Wood Preservers' Association.

Investigations of this kind will be continued through the inspection of fourteen service-test projects in 1930, followed by analysis of the results. Nine of these projects are to be covered by Whitney. Arrangements have been made with Supervisors of the Absaroka, Deerlodge, Jefferson, Madison and Helena Forests to secure annual inspection reports on five installations where timbers were treated with Anaconda Wood Preservative. Records obtained in this way will be reviewed in the District Office and forwarded to the Forest Products Laboratory.

RP - Sawmill Studies - Bradner

The object of these studies is to obtain information as follows: (1) The relative cost of manufacturing lumber and other forest products from logs and trees of different species and sizes. (2) The yield of lumber and other forest products by grade, width, length and thickness from logs and trees of different sizes and species. (3) Overrun figures for log runs of different species. (4) The efficiency of different types of equipment and methods of sawing as a means of reducing waste. (5) The amount of sawmill waste being produced, and (6) lumber depreciation in transporting, handling and seasoning and from fire, insect and fungus attack.

As a result of the 1924-25 sawmill studies, information was obtained on the first five of the above six objectives. These data have all been published in trade journal articles. In 1927 a mill scale study was made to determine the depreciation in fire-killed white pine. The office work of compilation is completed and the data will be analyzed and the results published in 1930. Considerable data on yields, costs, overrun, and sawmill practices were collected in the field season of 1928 in connection with the woods and mill studies on western yellow pine. This information is being analyzed and the results are being sent out to the co-operators. General results will be published in 1930 as a trade journal article.

It is planned to make a study of the depreciation in bug-killed white pine during the 1930 field season. Further information on sawmill practices will be obtained wherever mill scale studies are a part of logging and milling projects. The project is more or less continuous.

RP - Lumbering - Logging Output Bulletin - Bradner

This project has for its objective the preparation for publication as a departmental bulletin the data and results of the District's logging output studies. The new manuscript will be completed in the winter of 1930 and sent to the Washington Office for editing and approval.

The University of Idaho has an excellent program of research in forest products and utilization, comprising nine projects. Of these the utilization of native woods, and the studies on decay resistance of native woods are the two receiving the most effort. All nine projects are recognized, however, as promising practicable results and deserving of greater financial assistance.

In the utilization of native woods the work has shown the possibilities and advantages of using western red cedar for cigar boxes and for poultry houses. Tests on Idaho white pine match stock have shown the desirability of kiln drying in order to increase the strength of this product. The defect responsible for most of the failures in match stems was found to be diagonal grain. Blue stained lumber was found not only to be as strong as clear stock, when the match stems were tested by impact, but in some cases even stronger. New work in products research is being devoted to the yield of oils from needles and twigs of logging slash, to commercial uses of cellulose producing wood rot fungi, and to the development of certain fungi which produce chemical by-products of value in industry. The two latter phases are being conducted in co-operation with the Potlatch Lumber Company.

The investigations of decay resistance of native woods by the University of Idaho have been in progress since 1925, and have resulted in many practicable and fundamental discoveries. The effort has been devoted largely to the water soluble and volatile extractives of sapwood and heartwood; to the effect of moisture content on the growth of fungi, and to the technique of measuring decay resistance of different kinds of wood. Some of the results have been published in Industrial &

Engineering Chemistry, in the University of Idaho Bulletin No. 13, Vol. 24, 1929, and an additional report is now in preparation.

The other seven projects carried by the Idaho School of Forestry include studies of the cull due to rot in standing timber; the optimal and minimal moisture contents for the growth of decay fungi--a sub-project of one of the two major investigations mentioned above; the cause and prevention of sap stain; the rots found in wood products; the movement of moisture in wood; the diagnostic characteristics of the woods of the genus Abies; and the cause and control of water core in western white pine. Considerable work is in progress on all of these except the latter, which is temporarily suspended.

The University of Montana School of Forestry, in spite of its lack of funds for research work, has been making good progress on two of its researches in forest products and has initiated one new project. Lack of time and funds for essential equipment has prevented any progress, however, on the wood distillation investigation which was planned last year to attack the promising possibility of obtaining flotation oils and other products from sawmill waste.

Probably the most progress has been made in the development of electrical methods of measuring moisture in wood. In this work a relatively simple apparatus has been designed and found accurate for measuring the moisture content of inch boards when the diffusion of water in all samples is practically the same. At present the effort is being concentrated on the problem of measurement when the moisture is unevenly distributed. Work on the determination of the fiber saturation point in western yellow pine, by the University of Montana, has also encountered important variations, due to uneven distribution of moisture in wood, thereby again emphasizing the need for greatly expended investigations in this field. One important discovery made in the course of this and the last mentioned project, on electrical measurements, is the finding that according to the shrinking criterion, the fiber saturation point of western yellow pine is at about 31% moisture content, whereas the electrical method indicates this point to be at about 26%. Reasons for this difference are now being systematically sought. A new project is designed to supply some of this obviously essential information by determining the location of water in wood under definite temperature and humidity conditions. Both western yellow pine and Douglas fir are being studied in this new work.

Grazing

The importance of the grazing industry in this region and the exceedingly promising possibilities of improving practices so that costs may be reduced, returns to the permittees increased, the forage resource utilized more efficiently, and the range placed on a permanent producing basis, were clearly brought out and appreciated at the Spokane Council Meeting.

Contrasted with this, however, was the expenditure on grazing investigations of little more than $1,000 per year in contributed time,

which amounts to less than 1% of the total amount of the forest research investment. There is no doubt but that grazing is proportionately far more important than this in the economic constitution of the region, and the decidedly valuable results of what little research that has been done prove very clearly the potential ability of the scientific method to contribute to economic progress in this field. It is appreciated that other regions may have more spectacular problems, in erosion due to overgrazing, for example, and that this may assist materially in obtaining funds for research on such problems. But the fact was also brought out at the Spokane meeting that the method of assisting those regions whose present problems are largely due to bad past practice, to the neglect of those regions which prevented injurious grazing in the past, is in truth penalizing efficiency rather than assisting and encouraging it. The Council was unanimous in urging the value of extended range research in this region.

Only two agencies are conducting any grazing investigations in this region at the present time, and but ten projects are under way. On two of these projects the University of Montana is co-operating with the District 1 Office of Grazing, all of the remaining work being conducted by the latter office utilizing contributed time.

The following statement covers the range research work conducted by the Office of Range Management, or by the National Forest under the direction of that office:

1. Carrying Capacity. Poker Jim Experimental Pasture - Custer.

This project was initiated in 1925. Intensive studies of carrying capacity, volume production, calf crop, salting, losses, management, utilization and improved methods of measuring utilization and production of forage have been carried and reported on to the Council annually. Data collected during 1929 have not been compiled.

2. Carrying Capacity. Crow Creek Experimental Pasture - Helena.

This project was initiated in 1928. Two years' data have been collected. The field covered by this project is essentially the same as that covered by the Poker Jim Experimental Pasture project on the Custer, but is being conducted on a different type of range and under different natural conditions. Each project is representative of conditions on a large range area.

3. Plant Eradication. (Delphinium) Beaverhead, Beartooth, Madison.

This project was initiated in 1927 on the Beaverhead and Madison, and in 1929 on the Beartooth National Forest. The injection method of applying sodium chlorate was tried, and proving only partially successful was abandoned. The spraying method was begun in 1928. Data collected during 1928 and 1929 indicate that this method is effective. Final check will be made during the spring of 1930. Comparative costs and effectiveness of eradication are also being studied.

Calcium chlorate in powder form and in solution were also used. Tentative results indicate that this chemical applied by the same methods is not as effective as sodium chlorate in the same concentrations.

4. Plant Eradication. (Hypericum perforatum) Nezperce.

This project was initiated in 1928. Sodium chlorate sprayed on the plants proved successful in killing both the portions of the plants above ground and the root systems.

Calcium chlorate sprayed on the plants in 1929 resulted in a smaller percentage of kill of the plants treated than did the sodium chlorate. Examination of root systems for survival will be made in the spring of 1930.

5. Artificial Reseeding. Lewis & Clark.

This project was initiated in 1928. Results of the 1928 seeding, as checked in 1929, showed almost complete failure except on the cultivated check plot where fair results were obtained. The exceedingly dry season of 1929 was undoubtedly responsible for the poor results. Checks of the seeded areas will be continued until final results are had.

6. Handling Stock. Gallatin

This project as now conducted was initiated in 1927. The grazing management plan was completed in 1928 and complete data were obtained in 1929. Partial data are available for 1927 and 1928. This project is co-operative between the Montana Agricultural College and the Forest Service.

7. The Seed Factor in the Management of Ranges.

This project was initiated in 1926 and is co-operative between the Forest School of the University of Montana and the Forest Service. Seed samples were collected by the Forest Service and tested under Dean Spaulding's supervision. In 1926, 288 samples were tested; in 1927, 103 selected species were tested; in 1928, 200 samples were tested. The seed crop of 1929 was exceedingly light, allowing opportunity to test held-over seed of from one to five years of age during the winter of 1929. This investigation will be continued at least three years more.

8. The Growth, Development, and Extension of Range Plants.

This project is to be initiated in 1930. It will include a study of the growth requirements, development, and adaptability of species to this region with the intent of introducing better forage producers which will supplement the established species. Intensive studies of utilization, resistance of species to grazing use, as well as many other phases of the study of range plants can be carried under control in the range-plant nursery to be established. About five acres has been secured at the University of Montana for this purpose. This project is co-operative between the University of Montana and the Forest Service.

9. Carrying Capacity.

Special studies to determine the forage-acre allowance on various types of ranges are being conducted on the Jefferson and Nezperce for cattle and sheep and on the Beartooth for sheep, exclusive of the studies which are carried on in the experimental pastures on the Custer and Helena.

10. Seasonal Studies.

No special studies to determine dates of vegetative readiness and the management of stock on spring ranges were conducted during 1929, owing to shortage of funds.

There is a decided need for a small appropriation of about $500 for use in 1930 to initiate work in the experimental range plant nursery, mentioned above. This work should be started immediately so that the plant growth will be well established by the time range research personnel is assigned to this District. This would also allow considerable current work to be done previous to such assignment.

Ecology

The selection and designation of research reserves probably represents the most important effort now contributing to the study of ecology in the northern Rocky Mountain region. This work, which has been described in a previous section of this report, is decidedly essential to future ecological research when an environment of overmature virgin timber is desired. The urgent need of immediate action in preserving carefully selected areas of this kind is clearly recognized and the selections are being made as rapidly as possible.

Second in importance are the systematic phenological observations, now in their third year, at 29 stations in this region. A very worthy interest in this work has been shown by the field men. That may be due to the fact, however, that stations were selected within the various vegetative types partly according to the known ability of certain men to handle such work. The results have more than justified the forethought and care employed in selecting the stations and personnel for this study. The Experiment Station has checked over the records each year and taken up with the various observers such matters as have needed correction and guidance to secure completeness and uniformity of results. It is planned to make a preliminary correlation of data next winter after having three years' records on hand.

A third project in forest ecology, which because of the more urgent need of other work has not yet received the attention it deserves, is the establishment of an arboretum worthy of the name at the Priest River Branch Station. To this end a suitable area of about 300 acres was mapped last fall with a contour interval of 5 feet. This site has in part been used for experimental planting purposes for some years, and includes flat and sloping land; sandy loam, clay and gravelly soils;

dry, fresh, and marshy sites; as well as a variation in aspects from north to south, which it is hoped will show at least a slight difference in soil temperature. The next step is to make a soil reconnaissance of the area which will permit mapping the sites according to relative moisture and temperature characteristics of the soil and its physical structure. With this information it will be possible intelligently to allocate introduced exotic species to their proper sites. The purpose is to try out foreign and non-native American species as to their adaptability to northern Idaho forest conditions, and also to test out different racial or regional varieties of our own species. There are not only scientific, but extremely practical reasons for arboretum experimentation. As an example of this may be mentioned the effort to find a blister rust resistant 5-needled pine. Macedonian pine, Pinus peuce, has been recommended to us by European foresters in this connection, and we already have nursery stock started at Savenac Nursery for the purpose.

Two reports on previous ecological research, for which there is a quite considerable demand, include "Forest Types and Their Climatic Controls" and "Physical Factors in Site in Northern Idaho." The original work in both of these investigations was done by J. A. Larson when he was attached to the Northern Rocky Mountain Experiment Station. The completion of these reports has been hindered by the press of other work being carried by Mr. Larsen, who is now professor of Forestry at Iowa State College, Ames, Iowa. Publication of both of these reports is to be left to Mr. Larsen.

The University of Montana program of research recognizes three projects in ecology upon which work has been started, but which have not been possible to carry on continuously because of lack of funds and qualified student assistants. These projects are: The site requirements of western yellow pine; winter activities of western yellow pine; and root competition and tolerance of western yellow pine.

The Coeur d'Alene Office of the Bureau of Entomology recognizes the importance of forest succession and the ecology of timber stands in the development and the control of insect depredations. That office has for several years planned a study of forest succession from this viewpoint, but although some observations have been recorded, lack of funds and the press of other work have prevented the desired progress.

Silvics

Three silvical bulletins have been planned by the Experiment Station and one is now in course of preparation by the University of Montana.

Material has been collected by the Experiment Station from the field work of a number of men of its staff and the observations of others during the last 15 years pertaining to the silvics and management of western white pine. A manuscript for a bulletin was prepared by Mr. Rockwell in 1917, but the results of work since then have supplanted a good deal of his work and added so much new material that an entirely new preparation of manuscript is necessary. It is hoped that this can

be undertaken by Weidman and Haig next winter.

A proposed western yellow pine bulletin along the lines of the preceding report has been on Mr. Weidman's slate for several years. In view of the fact that his recently completed manuscript entitled "Timber Growing and Logging Practice in the Northwestern Yellow Pine Region" includes the practical features of the material intended for the silvicultural bulletin, it is felt that the latter might well be deferred in favor of the white pine bulletin. It is likely also that the western yellow pine studies made by the Pacific Northwest Experiment Station during the last few years have yielded results that logically should be combined with Mr. Weidman's earlier investigations in getting out a publication under joint authorship.

A report by Mr. Larsen entitled "Conifers of the Northern Rocky Mountains" has been completed in manuscript form and is now being reviewed preparatory to publication. In this connection, it should be mentioned that publication has just been made by the Stanford University Press of Dr. Kirkwood's book entitled, "Trees and Shrubs of the Northern Rocky Mountain Region", the manuscript of which was finished shortly before the author's death two years ago. This work is listed here because of its close co-ordination with similar silvical studies just described. Dr. Kirkwood's monograph, however, is largely in the field of dendrology and systematic botany, in which he was an indefatigable worker during his 20 years at the University of Montana.

Dendrology

Except for the work last described above, there are no research projects in dendrology under way in this region. It was not felt by the Spokane Council Meeting that this field of effort warrants the use of otherwise urgently needed research funds.

Economics

Research in forest economics and the routine collection and improvements of statistics pertaining to forest lands, forest products, etc., is accepted as fundamental and essential to the sound progress of forestry practice in the northern Rocky Mountain region. The Investigative Council was unanimous in its advocacy of the forest resource and economic survey in this region and action was taken by Major Kelley to enlist the interest of the Spokane Chamber of Commerce in a drive to obtain funds for this work.

The investigations and statistical work in forest economics by the District 1 Office of Forest Products has been outlined by Mr. Bradner, in charge of that office, as follows:

RE - Timber Survey of Private Lands - Bradner and Cunningham.

The object of this study is to obtain comprehensive information on the ownership, volume, age class, etc., of public and private timber and cut-over lands in and adjacent to the National Forests of Montana and

North Idaho. The project was initiated in 1921. The original survey and compilation on this project was completed in 1923. The project calls for a revision at five-year intervals. The first fifth-year revision was due in 1928-1929. During the winter of 1928-1929 two Forest officers were detailed for a two-month period on this project. Mr. Cunningham supervised the work. During this period the ownership and classification of the lands in six out of the ten North Idaho counties was corrected and brought up to date. Considerable work was done on mapping the timber types within the white pine counties. Burned and cut-over areas within Benewah and Shoshone Counties were also checked. No revision work was done on any of the Montana counties.

Work on this project will be continued regardless of the fact that the region will later be covered by a National Forest Survey. Assistant District Forester Shoemaker, in charge of Public Relations, is directing the progress of this work at present. The work is centralized in the District Office and two Forest officers are detailed to the job during the winter. Plans are under way to collect timber estimates by forties from one or more of the large timber owners in North Idaho and Montana.

RE - Lumbering Costs - Bradner and Neff.

This is an annual project. The object is to obtain the average annual logging and manufacturing costs for the District. Such cost figures are used in making stumpage appraisals and in arriving at production cost figures in many lines of Products and Logging Engineering work.

Detailed manufacturing costs are obtained annually from practically all of the band mill operators in the District. These data are listed in detail, summarized by species and mill groups and averaged in a report which is distributed within the Service and to co-operating companies. Logging costs, though obtained, are never collected in as much detail as manufacturing costs. One of the prominent operators in North Idaho has asked to have the logging costs collected and compiled in as much detail as the manufacturing costs. An attempt will be made in 1930 to collect the logging costs in detail from as many of the co-operators as possible. The information is obtained by personal interview.

RE - Prices - Mrs. Bullard and Mr. Anderson.

Current price records are secured for lumber (mill and retail), stumpage, logs, cedar products and ties. The lumber prices are obtained from the Western Pine Manufacturers' Association under contract and are compiled in quarterly and annual reports. Grade values per M for each species are plotted monthly in the form of a graph. Retail lumber and cedar products prices are issued in quarterly reports. Log and tie prices are collected and reported semiannually. The stumpage price report is made annually and includes representative figures for Forest Service; Indian Service, State and Private stumpage sold or purchased.

RE - Production, Annual Lumber Census - Whitney.

The canvass of all sawmills in Idaho and Montana was conducted as planned and completed on June 27, 1929. Over 500 establishments,

including 170 mills in South Idaho, canvassed by District 4, were covered. In addition to the production figures, information on lumber distribution and stumpage values was obtained from the principal mills. The returns were tabulated for District purposes and original schedules transmitted to the Bureau of the Census. A press notice showing the total production of lumber lath and shingles in the two States for 1928 in comparison with several other years was issued early in August. The preliminary figures presented in this press notice agree very closely with those compiled by the Bureau of the Census and released for publication at a later date. In comparing the results, differences between the two summaries amount to only 79M feet for Idaho and 93M feet for Montana, the District figures being slightly below the Bureau of Census totals in both cases.

This project is handled each year for the States of Idaho and Montana in co-operation with the Bureau of the Census. The program for 1930 will include all producers of lumber and timber products in the two States for the year 1929. Since this is one of the odd years when the biennial census manufactures is taken, a very intensive canvass will be required. In this case the canvass to be made is also considered to be a part of the decennial census which may require the collection of supplemental information in addition to that on stumpage values.

The District 1 Office of Lands has also been engaged in an economic research project for the past several years, and expects to complete it in 1930. This work has been devoted to the determination of the most economic use of 60,000 acres of publicly owned and tillable land on the Custer National Forest. Detailed investigations have been made of soil, weather, and various crop productivity.

The University of Idaho likewise for several seasons has been working on an economic project in the form of a forest survey of Benewah County, including a study of restocking on cut-over and burned-over lands. This is a most important subject in northern Idaho and the final report, which probably will be issued within the year, is awaited with great interest. Dean Miller reported at the Spokane meeting that the field work on this project was largely completed in 1929, and that the data show a large percentage of the area to be adequately stocked with fine young timber, many of the stands now being twenty to forty or more years old.

Two research projects in forest economics are being conducted by Dean Spaulding of the University of Montana School of Forestry. Both are of importance because of the present general activity and interest in forest taxation and in co-operative protection. The first of these is designated "A Study of the Possibilities for an Adequate Taxation System on Forest Soils in Western Montana"; the second, "A Study of Co-Operative Protection Agencies". Completion of both projects is tentatively planned for 1932. A preliminary report on the second project was made at the Northwest Scientific Association Meeting in December, 1929.

ORDER OF EXPERIMENT STATION EFFORT PLANNED FOR 1930

The following statement shows the relative order of effort to be devoted to lines of work by the Experiment Station during the calendar year 1930:

Line of Work	Cost	Per Cent
Fire Protection	$6,200	30
Priest River Experimental Forest	4,900	24
Methods of Cutting	4,400	21
Reproduction	1,900	9
Volume, Growth and Yield	900	5
Timber Growing and Logging Practice	800	4
Thinning	400	2
Arboretum	400	2
Experimental Forests and Research Reserves	400	2
Phenology	200	1
	$20,500	100

The assignment of members of the staff to projects will be tentatively as follows for the present calendar year:

	In Charge	Assistance
Fire Protection Projects	Gisborne	Field Asst. & Thompson
Priest River Experimental Forest	Weidman	Thompson
Methods of Cutting (Perm. sample plots)	"	Haig, Field Assts.& Thompson
" " " (Cut-over areas)	Haig	Computers
Reproduction (Perm. sample plots)	"	Field Assts. & Thompson
Volume, Growth and Yield	"	Computers
Timber Growing and Logging Practice	Weidman	
Thinning	"	Haig & Computers
Arboretum	"	Thompson
Experimental Forests & Research Reserves	"	
Phenology	"	Haig & 30 observers

ARTICLES AND PUBLICATIONS BY THE EXPERIMENT STATION

Submitted for Publication

1. Timber Growing and Logging Practice in the Northwestern Yellow Pine Region. R. H. Weidman. U.S.D.A. Bulletin.

2. Forest Fire Research. H. T. Gisborne. Accepted by Scientific Monthly.

3. A Five Year Record of Lightning Storms and Forest Fires in the Northern Rockies. H. T. Gisborne. Medium of publication not yet determined.

4. Conifers of the Northern Rocky Mountains. J. A. Larsen. U.S. D.A. Circular.

5. Recovery, Growth and Treatment of Understory Hemlock Released by Logging in the Western White Pine Type. I. T. Haig. Journal of Forestry.

6. Seed Germination During Natural Storage in Duff. I. T. Haig. Note for Ecology.

7. A Quarter Century of Silviculture in the Western White Pine Type. I. T. Haig. Forestry Kaimin of University of Montana.

8. Natural Reproduction in the Western White Pine Type. Robert Marshall. Progress Report.

Published in 1929

1. What is Research? R. H. Weidman. Northwest Science, Vol. 3, No.2, June, 1929.

2. The Industrial Revolution and Forestry. H. T. Gisborne. Journal of Forestry. Vol. 27, No.4, April, 1929.

3. The Complicated Controls of Fire Behavior. H. T. Gisborne. Note in Journal of Forestry. Vol. 27, No.3, March, 1929.

4. Accuracy of Quadrat Sampling in Studying Forest Reproduction on Cut-Over Areas. I. T. Haig. Ecology, Vol. X, No.4, October, 1929.

5. Relation of Quantity of Seed Sown and Density of Seedlings to the Development and Survival of Forest Planting Stock. W. G. Wahlenberg. Journal of Agricultural Research. February 15, 1929.

6. Modification of Western Yellow Pine Root Systems by Fertilization in the Nursery. W. G. Wahlenberg, Journal of Agricultural Research.

7. Investigations in Weed Control by Zinc Sulphate and other Chemicals at the Savenac Forest Nursery. W. G. Wahlenburg. U.S.D.A. Technical Bulletin, No.156, January, 1930.

In Preparation or Proposed for 1930

1. Yield, Stand and Volume Tables for Second Growth Western White Pine in Northern Idaho. I. T. Haig. U.S.D.A. Bulletin.

2. Reproduction and Residual Growth on Cut-Over Areas in the Western White Pine Type. I. T. Haig. Final Report.

3. Atmospheric Indices of Forest Inflammability. H. T. Gisborne. Article.

4. Where is the Forest Pyrologist? H. T. Gisborne. Article.

5. Results of Thinning Experiments in the Western White Pine Type. R. H. Weidman and Gerhard Kempff. Progress Report.

6. A Silvicultural Study of Western White Pine. R. H. Weidman and I. T. Haig. U.S.D.A. Bulletin.

ARTICLES AND PUBLICATIONS BY THE D-1 PRODUCTS OFFICE

Submitted for Publication

1. Properties and Use Bulletin for Western Larch. R.P.A. Johnson and M. Bradner. Dep't. Bulletin.
2. Lumber Production in Idaho and Montana. C. N. Whitney. Press Notice.

Published in 1929

1. Pitch-Treated Lodgepole Pine Poles Did Not Give Long Life. C. N. Whitney and R.M. Wirka. Article in Telephone Engineer and other technical journals.
2. Service Data on the Experimental Posts at Miles City, Montana, furnished in Whitney 1929 report used in a paper on fence-posts presented by R.M. Wirka at the American Wood Preservers Association.

In Preparation for Publication in 1930

1. Log Damage on Gravity Chutes. I. V. Anderson. Article in The Timberman.
2. Depreciation in Fire-Killed White Pine Timber. I. V. Anderson. Article in The Timberman.
3. Woods Waste in Logging in the Western White Pine Type. I. V. Anderson. Trade Journal Article.
4. Breakage Losses in Felling in the Western Yellow Pine Type. I. V. Anderson. Trade Journal Article.
5. Tree Values and Production Cost for Montana Western Yellow Pine. Recommendations for Selective Logging in the Western Yellow Pine Type of Montana. M. Bradner. Trade Journal Article.
6. Logging Output Bulletin. M. Bradner. Dep't. Bulletin.

EXPERIMENT STATION STAFF

R. H. Weidman	Director
H. T. Gisborne	Silviculturist
I. T. Haig	Associate Silviculturist
J. B. Thompson	Forest Ranger
Anna J. Bramseth	Clerk

EXPERIMENT STATION BUDGET F. Y. 1931

	SI	GE. D-1	GE-IMP.
Salaries (Permanent staff)	$15,680		
Expenses (" ")	1,600		
Salaries and Expenses Field and Office Assistants	1,830		
Maintenance and Operation of 2 Autos	300		
Equipment and Supplies	687		
Freight, Express & Hauling	150		
Maint. and Adm. Branch Station		$414	$1,393
Maintenance Team of Horses		200	
	$20,247	$614	$1,393